1. [7 points] How many significant figures should there be in the answer to the following problem?

\[(29.0025 + 0.2)/(6.1345 \times 36.101)\]

- (a) 1
- (b) 2
- (c) 3
- (d) 4
- (e) none of these

2. [7 points] From the list below identify those substances which are examples of compounds?

- (a) Zinc oxide
- (b) Platinum
- (c) Ethanol
- (d) Air
- (e) Both (a) and (c)

3. [7 points] If the density of milk is 1.04 g/cm\(^3\), what is the mass of 1.00 gallon of milk? You may need the following conversions: 1.057 quart = 1 Liter, 4 quarts = 1 gallon.

- (a) 3.64 kg
- (b) 4.40 kg
- (c) 4.07 kg
- (d) 3.94 kg
- (e) none of the above

4. [7 points] What is the correct name for H\(_3\)PO\(_3\)?

- (a) phosphate
- (b) phosphorous acid
- (c) hydrogen phosphite
- (d) phosphoric acid
- (e) perphosphoric acid

5. [7 points] What is the empirical formula of barium perchlorate?

- (a) BaClO\(_3\)
- (b) Ba(ClO\(_3\))\(_2\)
- (c) BaClO\(_4\)
- (d) Ba\(_2\)ClO\(_4\)
- (e) Ba(ClO\(_4\))\(_2\)
6. **[7 points]** Which of the following is the balanced chemical equation that describes the following reaction: solid iron (III) sulfate is added to an ammonium hydroxide solution leading to the formation of an iron (III) hydroxide precipitate.

- (a) \( \text{FeSO}_4\text{(s)} + \text{NH}_4\text{OH}\text{(aq)} \rightarrow \text{FeOH}\text{(s)} + \text{NH}_4\text{SO}_4\text{(aq)} \)
- (b) \( \text{Fe}_2(\text{SO}_4)_3\text{(s)} + 6\text{NH}_4\text{OH}\text{(aq)} \rightarrow 2\text{Fe(OH)}_3\text{(s)} + 3\text{(NH}_4)_2\text{SO}_4\text{(aq)} \)
- (c) \( \text{FeSO}_4\text{(s)} + 3\text{NH}_4\text{OH}\text{(aq)} \rightarrow \text{Fe(OH)}_3\text{(s)} + 3\text{NH}_4\text{SO}_4\text{(aq)} \)
- (d) \( \text{Fe}_3\text{SO}_4\text{(s)} + \text{NH}_4\text{OH}\text{(aq)} \rightarrow \text{Fe}_3\text{OH}\text{(s)} + \text{NH}_4\text{SO}_4\text{(aq)} \)
- (e) \( \text{Fe}_2(\text{SO}_4)_3\text{(s)} + \text{NH}_4\text{OH}\text{(aq)} \rightarrow \text{Fe}_2\text{OH}_3\text{(s)} + (\text{NH}_4)_2\text{SO}_4\text{(aq)} \)

7. **[7 points]** Which of the following atoms has the greatest number of protons?

- (a) \(^{55}\text{Cr}^{2+}\)
- (b) \(^{51}\text{Mn}^{4+}\)
- (c) \(^{49}\text{Ti}^{3+}\)
- (d) \(^{49}\text{Ti}^{4+}\)
- (e) \(^{52}\text{V}\)

8. **[7 points]** Which of the following atoms has the greatest number of electrons?

- (a) \(^{55}\text{Cr}^{2+}\)
- (b) \(^{51}\text{Mn}^{4+}\)
- (c) \(^{49}\text{Ti}^{3+}\)
- (d) \(^{49}\text{Ti}^{4+}\)
- (e) \(^{52}\text{V}\)

9. **[7 points]** Which of the following is most likely to be a good conductor of electricity?

- (a) \(\text{SiO}_2\)
- (b) \(\text{PCl}_5\)
- (c) \(\text{Cu}_3\text{Zn}_5\)
- (d) \(\text{Ar}\)
- (e) \(\text{H}_2\text{O}\)

10. **[7 points]** What is the empirical formula of a compound which is 68.0% vanadium and 32.0% oxygen by mass?

- (a) \(\text{V}_2\text{O}\)
- (b) \(\text{V}_2\text{O}_3\)
- (c) \(\text{V}_{17}\text{O}_8\)
- (d) \(\text{V}_2\text{O}_5\)
- (e) \(\text{VO}_2\)
11. [7 points] What is the empirical formula of the ionic compound formed between strontium and chlorine?

- (a) SrCl
- (b) Sr\textsubscript{2}Cl
- (c) Sr\textsubscript{2}Cl\textsubscript{3}
- (d) Sr\textsubscript{3}Cl\textsubscript{4}
- (e) SrCl\textsubscript{2}

12. [7 points] How many fluorine atoms are present in 55.6 g of calcium fluoride?

- (a) 8.58 \texttimes 10\textsuperscript{23} fluorine atoms
- (b) 4.29 \texttimes 10\textsuperscript{23} fluorine atoms
- (c) 1.13 \texttimes 10\textsuperscript{24} fluorine atoms
- (d) 5.67 \texttimes 10\textsuperscript{23} fluorine atoms
- (e) none of the above

13. [7 points] Two isotopes of chlorine are found in nature:

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Atomic Weight</th>
<th>Natural Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textsuperscript{35}Cl</td>
<td>35.0 amu</td>
<td>75%</td>
</tr>
<tr>
<td>\textsuperscript{37}Cl</td>
<td>37.0 amu</td>
<td>25%</td>
</tr>
</tbody>
</table>

Which of the following statements is false.

- (a) The average mass of a chlorine atom is 35.5 amu
- (b) No individual chlorine atom has a mass of 35.5 amu
- (c) \textsuperscript{37}Cl has two more protons than \textsuperscript{35}Cl
- (d) A 1.0 mole sample of Cl\textsubscript{2} will contain 3.0 \texttimes 10\textsuperscript{23} \textsuperscript{37}Cl atoms
- (e) Both (c) and (d) are false

14. [7 points] Balance the following equation and choose the quantity which is the sum of the coefficients of the reactants and products.

\[ a \text{Fe(NO}_3\text{)}_3 + b \text{NH}_3 + c \text{H}_2\text{O} \rightarrow d \text{Fe(OH)}_3 + e \text{NH}_4\text{NO}_3 \]

- (a) \( a + b + c + d + e = 7 \)
- (b) \( a + b + c + d + e = 11 \)
- (c) \( a + b + c + d + e = 22 \)
- (d) \( a + b + c + d + e = 5 \)
- (e) \( a + b + c + d + e = 9 \)
15. [7 points] Which of the following equations is the balanced chemical equation representing the combustion of propanol (C₃H₇OH)?

- (a) C₃H₇OH (l) + 9O(g) Û 3CO₂(g) + 4H₂O(l)
- (b) C₃H₇OH (l) Û 3CO₂(g) + 4H₂O(l)
- (c) C₃H₇OH (l) Û CO(g) + 4H₂(g) + 2C(s)
- (d) 2C₃H₇OH (l) + 9O₂(g) Û 6CO₂(g) + 8H₂O(l)
- (e) C₃H₇OH (l) + 5O₂(g) Û 3CO₂(g) + 4H₂O(l)

16. [7 points] If 36.7 g of aluminum is reacted with an excess of oxygen, according to the reaction below, to produce 61.0 g of aluminum oxide, what is the percent yield of Al₂O₃?

\[ 4\text{Al(s)} + 3\text{O}_2(g) \rightarrow 2\text{Al}_2\text{O}_3(s) \]

- (a) 87.9 %
- (b) 44.0 %
- (c) 114 %
- (d) 95.2 %
- (e) None of the above

17. [7 points] Tungsten reacts with Cl₂ to form WCl₆ according to the reaction given below. If 12.6 g of tungsten is treated with 13.6 g of Cl₂ what is the theoretical yield of WCl₆?

\[ \text{W (s)} + 3\text{Cl}_2 (g) \rightarrow \text{WCl}_6 (s) \]

- (a) 27.2 g
- (b) 25.4 g
- (c) 76.1 g
- (d) 50.7 g
- (e) None of the above

18. [7 points] What is the molarity of the solution formed by dissolving 81.0 g of sodium fluoride in water to form 2.00 L of solution?

- (a) 0.965 M
- (b) 1.93 M
- (c) 40.5 M
- (d) 0.664 M
- (e) 0.623 M

19. [7 points] What is the concentration of the solution which results when 50.0 mL of 1.0 M CuCl₂ solution is mixed with 100 mL of 4.0 M CuCl₂ solution?

- (a) 0.45 M
- (b) 2.0 M
20. [7 points] Which of the following is not an example of a metathesis reaction?

- (a) HNO₃ (aq) + KOH (aq) → H₂O (aq) + KNO₃ (aq)
- (b) 2Cr(NO₃)₃ (aq) + 3(NH₄)₂CO₃ (aq) → Cr₂(CO₃)₃ (s) + 6NH₄NO₃ (aq)
- (c) 2HCl (aq) + Na₂S (s) → NaCl (aq) + H₂S (g)
- (d) Mg (s) + 2HNO₃ (aq) → H₂(g) + Mg(NO₃)₂ (aq)
- (e) Both (c) and (d) are not examples of metathesis reactions

21. [7 points] Which of the following combinations of reactants would lead to the occurrence of an oxidation-reduction reaction?

- (a) Ag (s) + HCl (aq)
- (b) Zn (s) + NiCl₂ (aq)
- (c) Ca(NO₃)₂ (aq) + ZnCl₂ (aq)
- (d) Ag (s) + Au (s)
- (e) Cu (s) + ZnCl₂ (aq)

22. [7 points] Which of the following compounds is a weak electrolyte?

- (a) NaCl
- (b) H₃PO₄
- (c) octane, C₈H₁₈
- (d) KOH
- (e) H₂SO₄

23. [7 points] What volume of 0.0916 M BaCl₂ solution will react completely with 0.475 g of Na₂SO₄?

\[
\text{BaCl}_2 (aq) + \text{Na}_2\text{SO}_4 (aq) \rightarrow \text{BaSO}_4 (s) + 2\text{NaCl} (aq)
\]

- (a) 0.306 mL
- (b) 51.9 L
- (c) 33.4 mL
- (d) 36.5 mL
- (e) 41.6 mL

24. [7 points] What of the following is the correct balanced net ionic equation for the reaction between silver hydroxide and hydrochloric acid?

- (a) AgOH (s) + HCl (aq) → H₂O (l) + AgCl (s)
- (b) AgOH (s) + H⁺ (aq) → H₂O (l) + Ag⁺ (aq)
• (c) OH⁻ (aq) + H⁺ (aq) → H₂O (l)
• (d) Ag⁺ (aq) + Cl⁻ (aq) → AgCl (s)

25. [7 points] Given 1.00 g of an unknown sulfate salt, ASO₄, the following steps are performed:

1. The salt is dissolved in water
2. An excess of BaCl₂ is added resulting in the formation of a precipitate
3. The sample is washed and dried. The mass of the precipitate is determined to be 1.45 g

We can write the following chemical equation to represent steps 1 & 2

\[ \text{ASO}_4 (aq) + \text{BaCl}_2 (aq) \rightarrow \text{BaSO}_4 (s) + \text{ACL}_2 (aq) \]

What is the identity of the cation A?

• (a) Mn²⁺
• (b) Mg²⁺
• (c) Fe²⁺
• (d) Pb²⁺
• (e) Zn²⁺